Minnesota
Burn Surge Education
Introduction

- Module 1: Minnesota Statewide Burn Surge Planning
- Module 2: Introduction to Burn
- Module 3: Burn Treatment and Stabilization
- Module 4: Special Treatment Considerations
Module 1:
Minnesota Statewide Burn Surge Planning
Objectives

Why is this necessary

MN Burn Surge Plan

Resources
Why is this necessary

- Multiple Burn Causalities Incident can quickly overwhelm Burn Centers
- Limitations for capacity and burn trained personnel
- Burn Care is a specialized service
Definition of a Burn Disaster

A burn disaster is defined by the American Burn Association (ABA) as any incident where capacity and capability is insufficient, patient care may be compromised, patient care is possible, and may require an individual Burn Center, state, regional, or federal disaster response.
Objectives

Why is this necessary

MN Burn Surge Plan

Resources
MN Burn Surge Plan: 3 Phases

Phase 1 – Local Response
- All agencies are to follow normal operating referral and transportation protocols.
- HCMC Burn Center licensed for 17 beds and can surge up to 25 beds.
- Regions Burn Center licensed for 18 beds and can surge up to 25 beds.
- MN Burn centers will provide communication to requesting hospital within an hour

Phase 2 – MN Burn Center and Metro Regional Response
- Burn Center Medical Directors will assist in decision making of patient transport to Burn Surge Facilities or outside MN.
- Metro Regional hospitals will surge as needed to assist in increasing regional capacity of treating burn victims.

Phase 3 – MDH State Response
- Burn Surge Facilities will be activated and receive instructions on definitive care for any patients they are stabilizing. Decision should be within 6-8 hours of activating state plan.
- National Inter-State partners will be activated: Mid-West ABA Region – Nebraska and DHHS Region V: Great Lakes Health Partnership
MN ABA verified Burn Centers

- Hennepin County Medical Center
- Regions Hospital

- National verification by the American Burn Association (ABA) & the American College of Surgeons - Committee on Trauma (ACS-CoT)

- Integrated multidisciplinary teams - optimal functional & cosmetic outcome

- Experienced care of burn injuries of any size or mechanism in all ages
  - associated trauma
  - multiple medical conditions
  - physical, occupational & psychological care, rehabilitation and reintegration
  - integrated regional mass casualty coordination
## Burn Surge Facilities

<table>
<thead>
<tr>
<th>Burn Surge Facility</th>
<th>Regions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mayo Clinic Hospital – Rochester</td>
<td>Facility will serve as point of referral for both SE and SC regions.</td>
</tr>
<tr>
<td>Sanford – Worthington</td>
<td>Facility will serve as point of referral for SW region.</td>
</tr>
<tr>
<td>St. Cloud Hospital</td>
<td>Facility will serve as point of referral for both Central and WC regions.</td>
</tr>
<tr>
<td>Altru – Grand Forks</td>
<td></td>
</tr>
<tr>
<td>Sanford – Fargo</td>
<td>Facility will serve as point of referral for both NW and WC regions.</td>
</tr>
<tr>
<td>Essentia Health – Fargo</td>
<td></td>
</tr>
<tr>
<td>Essentia Health – Duluth</td>
<td>Facility will serve as point of referral for NE region.</td>
</tr>
<tr>
<td>Abbott Northwestern</td>
<td>Facility will serve as point of referral for Metro region.</td>
</tr>
<tr>
<td>Children’s Hospitals &amp; Clinics</td>
<td></td>
</tr>
<tr>
<td>Mercy Hospital</td>
<td></td>
</tr>
<tr>
<td>North Memorial</td>
<td></td>
</tr>
<tr>
<td>UMMC – M Health</td>
<td></td>
</tr>
</tbody>
</table>
Severely burned patients require a dedicated burn facility for definitive care.  
*Note: Info recommended below is taken from MN Burn Surge Plan*

## Role of Burn Surge Facility

### Initial Assessment & Treatment

- Recognize and treat any associated trauma
- Diagnose burn size & initial depth
- Initial burn dressings/wound care
- Continue resuscitation

### Stabilization (72H)

- Surgical/Critical Care Management
- Communication with Incident Command Center
- Supportive care: fluids, analgesia, ventilator support, nutrition
- Plan and coordinate transfer to Verified Burn Center for definitive management
Objectives

Why is this necessary

MN Burn Surge Plan

Resources
Resources

- MDH Burn Surge website
  http://www.health.state.mn.us/oep/healthcare/burn/
- American Burn Association
  http://ameriburn.org/
- HCMC Burn Center
  http://www.hcmc.org/clinics/burncenter/
- Regions Hospital Burn Center
Module 2: Introduction to Burn
Objectives

Discuss the nature and epidemiology of burn injuries

Overview of skin and burn classifications
Incidence

- 1.25 Million injuries / year
- 450,000 patients seek treatment per year
- 40,000 patients hospitalized annually
- 3,400 deaths from burn injuries
- 96.1% overall survival rate
Epidemiology

Demographics

Gender
- 69% Male
- 31% Female

Ethnicity
- 59% Caucasian
- 19% African-American
- 15% Hispanic
- 7% Other
Epidemiology

- **Injury Types**
  - 44% fire/flame
  - 33% scald
  - 9% contact
  - 4% electrical
  - 3% chemical
  - 7% other
Epidemiology

- **Location**
  - 69% Home
    - Kitchen - scald
  - 9% Occupational
  - 7% Street/Hwy
  - 5% Recreational/Sport
  - 10% Other
High Risk Groups

- **Children**
  - Scald injuries most common
- **Elderly**
  - Flame injuries most common
  - Pre-existing conditions
High Risk Groups

- Chemical intoxication
  - Risk-taking behavior
  - Impaired responsiveness
  - 40% of house fire deaths are associated with substance abuse
Objectives

Discuss the nature and epidemiology of burn injuries

Overview of skin and burn classifications
Skin Function

- Protects from infection and injury
- Regulates body temperature
- Prevents loss of body fluids
- Sensory contact with environment
Skin Anatomy

- Epidermis
- Dermis
- Dermal Appendages
- Subcutaneous Tissue
An injury to tissue usually caused by heat but also by abnormal cold, chemicals, poison gas, electricity, or lightning.
Burn Wound Zones

**Zone of Coagulation**
- Dead and stays dead regardless of Rx

**Zone of Stasis**
- Area of vessel contraction
- Inflamed
- Ischemic
- ± viable depending on care

**Zone of Hyperemia**
- Vessel dilatation
- Capillary permeability
- Viable with good care and no infection
Burn Depth

- Four categories
  - First Degree
  - Second Degree
  - Third Degree
  - Fourth Degree
First Degree Burn
(Superficial)

- “Sunburn” injury
- Epidermis only
- No scarring
- No disfigurement

Note: First degree burns do NOT count toward calculation of TBSA burned
Second Degree Burn (Partial-Thickness)

- Entire epidermis and part of dermis
- Pink and blistered
- Most painful
- Heals in 2-3 weeks
  - Via Dermal Appendages
- Pigmentation changes
- Minimal scarring
- +/- skin grafting
Third Degree Burn
(Full-Thickness)

- Entire dermis and epidermis
- White, dry appearance
- Coagulated vessels
- Scarring and disfigurement
- Heals by contracture
- Skin grafting indicated
Fourth Degree Burn
(Deep Full-Thickness)

- Burn into underlying structure
- Often charred
- Disfigurement
- Disability
Module 3:
Burn Treatment and Stabilization
Objectives

Describe the basics of initial burn assessment and management

Discuss follow up care and/or transfer criteria

Discuss special situations pertaining to burn mechanism
Initial Care

- Stop the burning process
- Initial resuscitation flows just like trauma
  - Airway
  - Breathing
  - Circulation
  - Disability
  - Exposure
  - Fluids
### Indications for Intubation

<table>
<thead>
<tr>
<th>Indication</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hoarseness, voice change</td>
<td>Airway/Breathing</td>
</tr>
<tr>
<td>Stridor</td>
<td></td>
</tr>
<tr>
<td>Large TBSA burn (&gt;50%)</td>
<td></td>
</tr>
<tr>
<td>Extensive facial burns</td>
<td></td>
</tr>
<tr>
<td>Burns inside mouth</td>
<td></td>
</tr>
<tr>
<td>Significant burn edema</td>
<td></td>
</tr>
<tr>
<td>Signs of obstruction</td>
<td></td>
</tr>
<tr>
<td>Difficulty swallowing</td>
<td></td>
</tr>
<tr>
<td>Using accessory muscles</td>
<td></td>
</tr>
<tr>
<td>Inability to handle secretions</td>
<td></td>
</tr>
<tr>
<td>Respiratory fatigue</td>
<td></td>
</tr>
<tr>
<td>Poor oxygenation/ventilation</td>
<td></td>
</tr>
<tr>
<td>Very large doses of narcotics</td>
<td></td>
</tr>
<tr>
<td>Impaired level of consciousness, not protecting airway</td>
<td></td>
</tr>
</tbody>
</table>
Circulation

Assess for pulses in extremities and hemodynamic stability

If there is active hemorrhage control with direct pressure – if this fails, tourniquet and or surgical control may be used

The burn will remain stable throughout hemorrhage stabilization

Resuscitate with Crystalloid (LR) and blood products as needed to treat hypotension in addition to burn fluid resuscitation
Burn Dressing Recommendations

- Cool burn
- Prevent hypothermia
- Dry dressing
Objectives

Describe the basics of initial burn assessment and management

Discuss follow up care and/or transfer criteria

Discuss special situations pertaining to burn mechanism
Referral Criteria for Burn Center

- > 10% TBSA
- Face, hands, feet, genitals, perineum, major joints
- Third degree
- Electrical, including lightning
- Chemical burns
- Inhalation injury
- Pre-existing conditions
- Associated trauma
- Pediatrics
- Special social, emotional, rehab needs

MDH
Prep for Transfer

- SECURE all lines/tubes
- Dry sterile covering to wounds
- Don’t delay transfers for Imaging and labs
- Tetanus booster
- Continuous IV fluids – Parkland Formulas
- Air vs. ground
- Most admit directly to Burn Centers if able
- If unable to transfer to burn center with above criteria please refer to module 2
Parkland Formula

- 2-4 mL/kg/%TBSA over 24 hours with the first half infused in first 8 hours since time of initial burn

Example: 30% TBSA in a 70kg patient

\[4\text{mL} \times 70 \times 30 = 8400\text{mL}\]
4200mL in first 8 hours

Example: 60% TBSA in a 20kg child

\[2\text{mL} \times 20 \times 60 = 2400\text{mL}\]
1200mL in the first 8 hours
Estimating Percent TBSA

1% TBSA = size of patient hand (whole palmer surface)
“Rule of Nines”

Rule of Nines
Measure 2nd and 3rd Degree Burns

A Patient's hand ~ 1% of the total body surface area

© Damian Rispoli, MD 2010
Guidelines for Safe Transport

- Keep Patient warm and dry, no wet dressings
- Secure airway if necessary before transport
- Initiate fluid resuscitation
- Foley catheter in place
- Tetanus prophylaxis
- Continue pain and sedation medications
- No Bolus therapy unless overtly hypotensive
Transport issues (Ground and Rotary Transport service areas)

<table>
<thead>
<tr>
<th>Air Service</th>
<th>Rotor Wing</th>
<th>Fixed Wing</th>
<th>IFR Rotor Capability</th>
<th>Dispatch</th>
<th>Bases</th>
<th>Hospital System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avera Careflight</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>1-800-592-1889</td>
<td>SD</td>
<td>Avera</td>
</tr>
<tr>
<td>Life Link III</td>
<td>X</td>
<td>X</td>
<td></td>
<td>1-800-328-1377</td>
<td>MN, WI</td>
<td>Hospital Consortium</td>
</tr>
<tr>
<td>Mayo One</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>1-800-237-6822</td>
<td>MN, WI</td>
<td>Mayo Clinic</td>
</tr>
<tr>
<td>MedLink AIR</td>
<td>X</td>
<td>X</td>
<td></td>
<td>1-800-527-1200</td>
<td>WI</td>
<td>Gunderson Health System</td>
</tr>
<tr>
<td>Mercy Air Med</td>
<td>X</td>
<td></td>
<td></td>
<td>1-877-463-7291</td>
<td>IA</td>
<td>Mercy North Iowa</td>
</tr>
<tr>
<td>Ministry Spirit Air</td>
<td>X</td>
<td></td>
<td></td>
<td>1-888-411-1362</td>
<td>WI</td>
<td>Ministry Health Care</td>
</tr>
<tr>
<td>North Memorial Air Care</td>
<td>X</td>
<td></td>
<td></td>
<td>1-800-247-0229</td>
<td>MN, WI</td>
<td>North Memorial Medical Center</td>
</tr>
<tr>
<td>NorthStar Criticair</td>
<td>X</td>
<td></td>
<td></td>
<td>1-800-223-1596</td>
<td>ND</td>
<td>Trinity Health</td>
</tr>
<tr>
<td>Sanford Air Med</td>
<td>X</td>
<td>X</td>
<td></td>
<td>1-844-424-7633</td>
<td>MN, ND, SD</td>
<td>Sanford Health</td>
</tr>
<tr>
<td>Valley Med Flight</td>
<td>X</td>
<td>X</td>
<td></td>
<td>1-800-828-0168</td>
<td>MN, ND, MI</td>
<td>Independent</td>
</tr>
</tbody>
</table>
Transportation Services and their logos
Criteria for Observation/Outpatient Care

- <10% TBSA
- 1st and 2nd degree burns
- Non-circumferential burns
- Questionable inhalation exposure
- Intractable pain patients
- Need for IV hydration
Prep for Outpatient Clinic

- Bacitracin or Triple antibiotic/Adaptic (B&A) dressings
  - Silvadene alters wound appearance
- Supplies to change dressings daily
- Oral pain medication
- Tetanus booster
- Discharge Info to include contact information for follow up
Options of Burn Dressings for Outpatient

- Bacitracin
- Adaptic
- Mepitel
- Kerlix Gauze
- Stockinet
- Coban
Objectives

1. Describe the basics of initial burn assessment and management
2. Discuss follow up care and/or transfer criteria
3. Discuss Special Situations Pertaining to Mechanisms
Special Circumstances

- Electrical injuries
- Inhalation injuries
- Chemical burns

- NOTE: Radiation injuries not included here as the burn component is a minor issue compared to the acute radiation exposure issues – Contact on call specialists at MN Regional Poison Center 800-222-1222 for chemical and radiation issues.
Electrical injuries

- Cardiac monitor and EKG required
- Monitor CK levels for rhabdomyolysis, treat with increased IVF and urine alkalization
- Injury is largely considered an inside-outside injury
  - Meaning muscle and internal compartment damage may be major but the external signs are often minor
  - Continue to evaluate for compartment syndromes
- Considered significant when involved Voltage > 1000 volts
- Consider labs for lactic acid
Inhalation Injury

- Smoke inhalation is a ‘toxic soup’
  -Particles and chemicals

- Carbon Monoxide (CO) poisoning
  - 200x > affinity for Hgb than O\(_2\)
  - SpO\(_2\) abnormally elevated (normal on monitor)

- Half life
  - Room air: 250 mins
  - 100% FiO\(_2\): 40-60 mins
  - 3 atm HBO: 20 mins
## CO Poisoning

<table>
<thead>
<tr>
<th>CO Hgb Saturation (%)</th>
<th>Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-9%</td>
<td>None</td>
</tr>
<tr>
<td>10-20%</td>
<td>Headache, vasodilation</td>
</tr>
<tr>
<td>20-30%</td>
<td>Headache, pulsating temples</td>
</tr>
<tr>
<td>30-40%</td>
<td>Severe headache, nausea/vomiting, weakened sight, prostration</td>
</tr>
<tr>
<td>40-50%</td>
<td>As above, increased RR and HR, asphyxiation</td>
</tr>
<tr>
<td>50-60%</td>
<td>As above, coma, seizure, cheyne-Stoke breathing</td>
</tr>
<tr>
<td>&gt; 60%</td>
<td>Coma, seizure, cardiopulmonary collapse, death</td>
</tr>
</tbody>
</table>
Inhalation Injury

- **Cyanide (CN) poisoning**
  - Commonly produced by synthetic compounds (i.e. burning carpet, vinyl and household goods)
  - Binds to cytochrome oxidase
    - Blocks cellular respiration
    - Synergy with CO
  - Effects within seconds of inhalation
  - Persistent lactic acidosis resistant to resuscitation
  - ALWAYS consider with closed space smoke exposure
  - Lab: Consider cyanide and lactic acid levels
Inhalation Injury

Treating CN Poisoning

“Old” Cyanide kit (Lilly Cyanide Antidote)
- Amyl nitrate, thiosulfate, sodium nitrite
- Methemoglobin generators

“New” Cyanide kit (Cyanokit)
- Hydroxycobalamine (Vit B12 precursor) 5 mg x1
- May repeat dose x1
- Side effects – flushing, HTN, lab interference
Trauma Always Trumps Burn
Chemical Burns

Initial treatment of Chemical Injuries

- Contact Poison Control for treatment recommendations – 800-222-1222
- No acid/base reversal, can monitor pH of skin while irrigating
- Alkali burns (base) are far more dangerous and may require long-term irrigation
- Place in saline dressing for 1st 24-48 hours as the petroleum's in topical creams can lock in the chemicals causing the burn

MDH
Module 4:
Special Treatment Considerations
Objectives

Escharotomy

Pain Management

Threats to the Burn Patient
Escharotomy

- Contact Burn Center or Burn Surge Facility for guidance
- Considerations:
  - If unable to bag a patient
  - Generally circumferential chest full thickness burns
Objectives

Escharotomy

Pain Management

Threats to the Burn Patient
Pain Management

- Burn patients require large amounts of pain medication

- Pain and analgesic treatment should be assessed hourly and adjusted to achieve adequate pain control
Objectives

Escharotomy

Pain Management

Threats to the Burn Patient

MDH
Specific Threats to Burn Patients

- Burn Shock
- Burn Sepsis
- Hyperglycemia
- Hypothermia
# Burn Shock

**Burn Patients typically die from one of two causes**

- “Burn shock” resulting in early deaths
- Multiple organ failure and sepsis leading to late deaths

**Burn shock is multifactorial**

- Hypovolemic distributive shock *plus*
- Mediator dependent reduction of cardiac output also contributes to the “burn shock” state, this is similar to a high output cardiogenic shock
- This can be significant in patients with an underlying heart disease, such as congestive heart failure
Burn Sepsis

- Typically results in late burn deaths

- "Burn sepsis" prevention is facilitated by the early removal of devitalized tissue (eschar)
  - Typically try to have devitalized eschar removed within one week
  - Removal of eschar relieves the patient of heavily colonized wounds that lead to recurrent episodes of bacteremia

- Surface cultures can guide early antimicrobial therapy, however it is generally accepted to treat the septic burn patient with empiric broad spectrum antibiotics

- Avoid the obvious critical care infections: line infections, VAE, etc... and identify and treat these infections early
Hyperglycemia control

Considerations/Recommendations

- Stress hyperglycemia is common
- Treat with insulin drip or subcutaneous insulin as needed to achieve serum blood sugars of 100-180
Hypothermia

Continuous monitor of patient temperature

Thermoregulatory control is dependent on inputs from the:

- Skin (the ultimate breathable insulating garment!)
- Central nervous system stimulation
- External interpretations of the environment by the brain

With large burns, the body is unable to use these thermoregulatory pathways resulting in hypothermia

Prevention is the best treatment

- Heat rooms to >80 degrees Fahrenheit
- Warm fluids
- Bair huggers, and external heating devices may be required to maintain normothermia

MDH
Special Thanks to...

- **American Burn Association Advanced Burn Life Support Course 2016** for supplying images from the American Burn Association Advanced Burn Life Support Course 2016.

- **Regions Hospital Burn Center** for providing their expertise in the development of this education.

- **Hennepin County Medical Center Burn Center** for providing their expertise in the development of this education.

- **MN Health Coalition Partners** for their partnership in the development of this education.
THANK YOU

For more information, please contact:

Angie Koch, MPH
Planning Director State – Medical Surge
Minnesota Department of Health
Emergency Preparedness and Response

Health.hpp@state.mn.us
651-201-5700